Space Weather Technical Forecast

Issued on Saturday, 29 April 2023 at 13:05 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of R1/R2 throughout. Active electron fluence expected. Slight and declining chance of G1.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low in the past 24 hours, with several C-class flares, with the largest event a C9 flare, peaking at 29/1017 UTC from AR3288, which is the most interesting region on the disc, with growth in intermediate spots and a delta spot within that area. AR3289 in the northwest has also produced a long period C-flare, with this region having grown in the last 24 hours. The other two sunspot regions on the disc are small and more simple. There have been numerous mainly weak and faint eruptions appearing in coronagraph imagery in the last 24 hours. Generally speaking, any CMEs are considered most likely to miss Earth, although some glancing influence from several different sources cannot be ruled out in the coming days. As a result, the forecast should be considered of lower than average confidence at present. Meanwhile, an eruption which occurred at 29/0400 UTC (and associated dimming) near the vicinity of AR3288, produced a CME, although there is no evidence of a filament near this region. This CME is currently under going analysis for any potential Earth-directed component.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by ACE and DSCOVR at L1, was reflective of continuing fast wind enhancement from CH96/-. The wind speed has been at Strong levels, mainly between 600-700km/s, briefly declining to Elevated levels, below 600km/s. Density was below average. The IMF, Bt, was weak at 5-6nT, with the north-south component, Bz, mostly weakly southward directed between +5 to -6 nT. The phi angle has been mostly negative (towards the Sun). Geomagnetic activity was Unsettled to Active (Kp 3-4).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) as measured at GOES16, has been at background levels throughout.

High energy electron flux (greater than 2MeV) as measured at GOES16, reached High levels at the diurnal maxima, peaking at 5970 pfu at 28/1630 UTC. The 24-hour integrated fluence rose to reach Active levels, with 1.38e8 integrated pfu recorded at 29/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to remain Low, with a chance of reaching Moderate levels through the coming days.

Solar Wind / Geomagnetic Activity: There have been numerous mainly faint filament eruptions appearing in coronagraph imagery over the past few days. All of these CMEs are considered most likely to miss Earth, but with a low chance of the odd glancing blow at times through the forecast period. The current fast wind from CH96/- is expected to start the period at strong levels, with wind speeds starting to ease into Day 2 (30 Apr). A further coronal hole, CH98/-, may prolong elevated or slightly elevated wind speeds into Days 3 and 4 (01-02 May).
Geomagnetic activity is expected to be Unsettled to Active at first with a slight chance of

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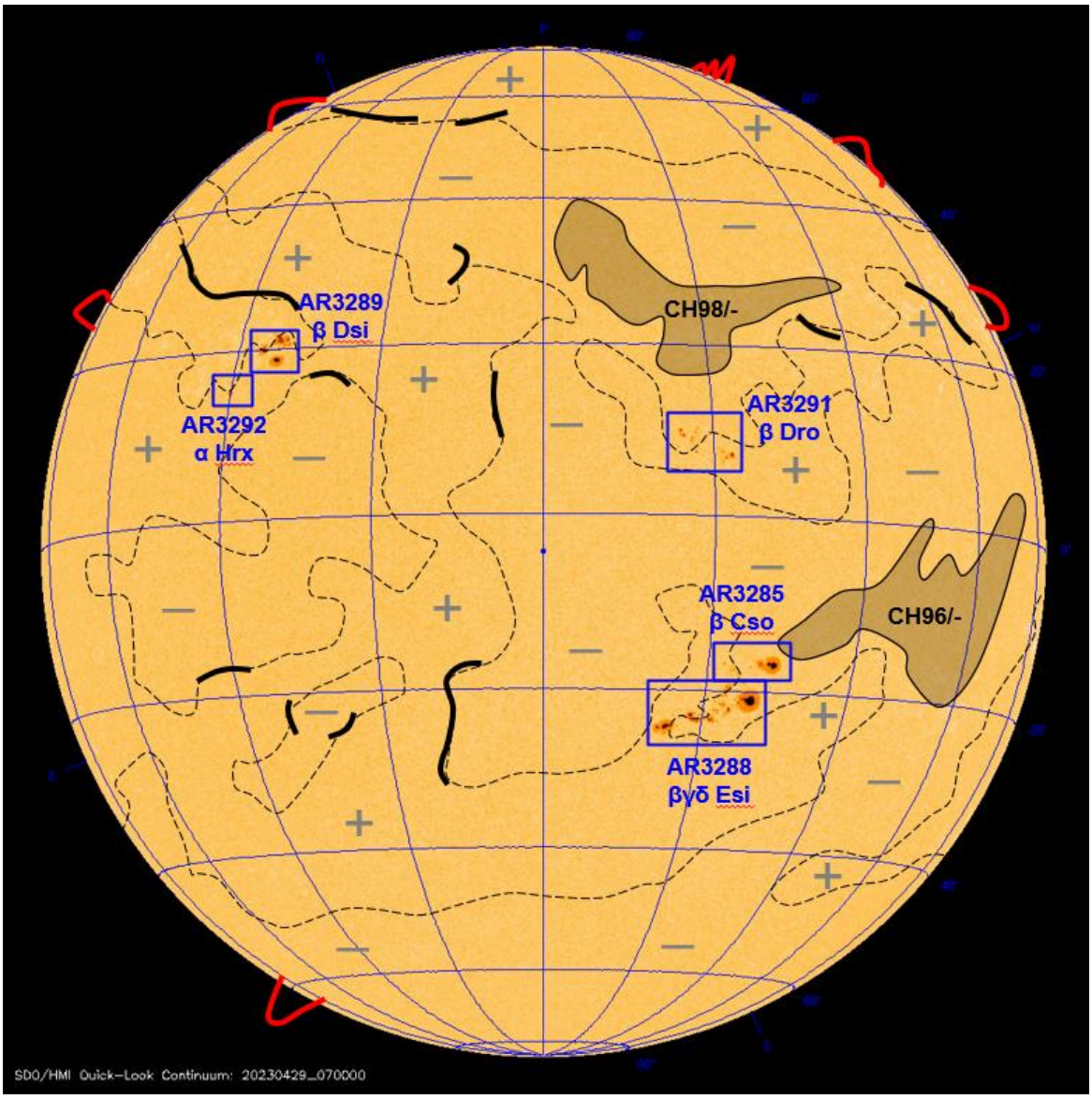
G1/Minor Storm intervals. This gradually declining to become mostly Quiet through the period, although Unsettled to Active intervals are possible once again should we see any glancing CME influence.

Energetic Particles / Solar Radiation: Overall no solar radiation storms are expected, but there is a slight chance of a storm occurring, mainly due to the westward advance of AR3288.
High energy (greater than 2MeV) electron flux at GEO is reaching High levels at the diurnal maxima and is expected to continue to do so through the coming days. Electron fluence is currently above Active (1e8 integrated pfu) and is most likely to remain so, perhaps on a rising trend.

Figure 1. Solar Analysis Valid 29/0700 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There have been numerous mainly faint filament eruptions appearing in coronagraph imagery over the past few days. These various CMEs have been largely directed away from Earth, but with the possibility of some glancing influence at various times throughout the forecast period. All of these CMEs are considered most likely to miss Earth, but with a low chance of the odd glancing blow as suggested by the MOSWOC Enlil ensemble.

A recent eruption near AR3288, which occurred at 29/0400 UTC, produced a CME, which is currently being analysed for any potential Earth-directed component. However, this eruption doesn't appear to be associated with any filament located within the vicinity of AR3288 (as seen in GONG imagery) so probably a reconfiguration of the complex magnet field associated with this complex region and its neighbouring AR3285.

The fast wind from CH96/- is expected to start the period at similar levels to those currently being experienced, with the strong solar wind speeds starting to ease into Day 2 (30 Apr). A further coronal hole, CH98/-, is currently in the northern hemisphere just west of centre disc. Being further north, it may be that the HSS from this feature passes above Earth as suggested by Enlil. However, it is possible that this feature may prolong elevated or slightly elevated wind speeds into Days 3 and 4 (01-02 May).

Geomagnetic activity is expected to be Unsettled to Active at first with a slight chance of G1/Minor Storm intervals. This gradually declining to become mostly Quiet through the period, although Unsettled to Active intervals are possible once again should we see any glancing CME influence.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	20	10	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Any CMEs are currently considered most likely to miss Earth.

Figure 2: MOSWOC Enlil and ensemble. The ensemble shows the slight chance of various CME glancing blows through the period. Enlil is forecasting the HSS from CH98 to miss Earth, but there is a risk of continued slightly elevated or perhaps elevated wind speeds later in the period.

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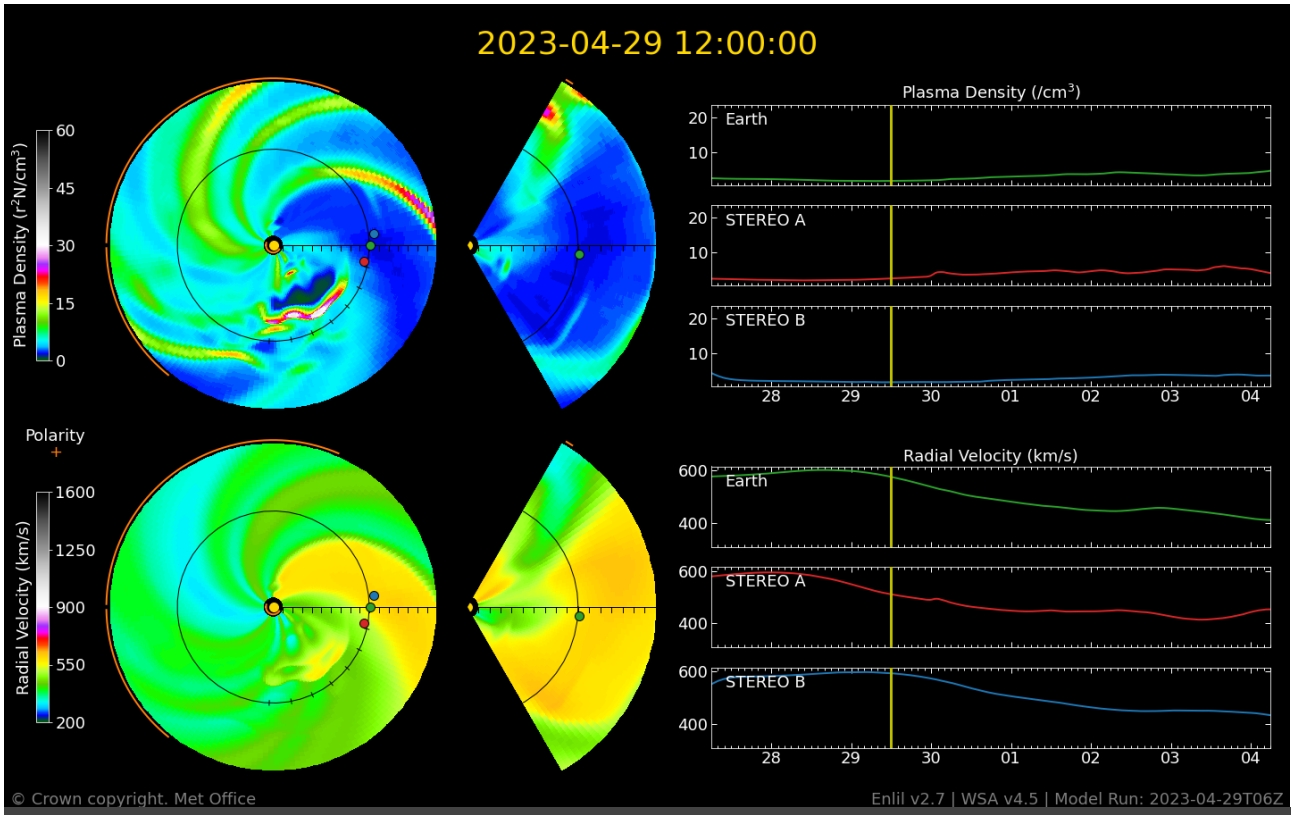
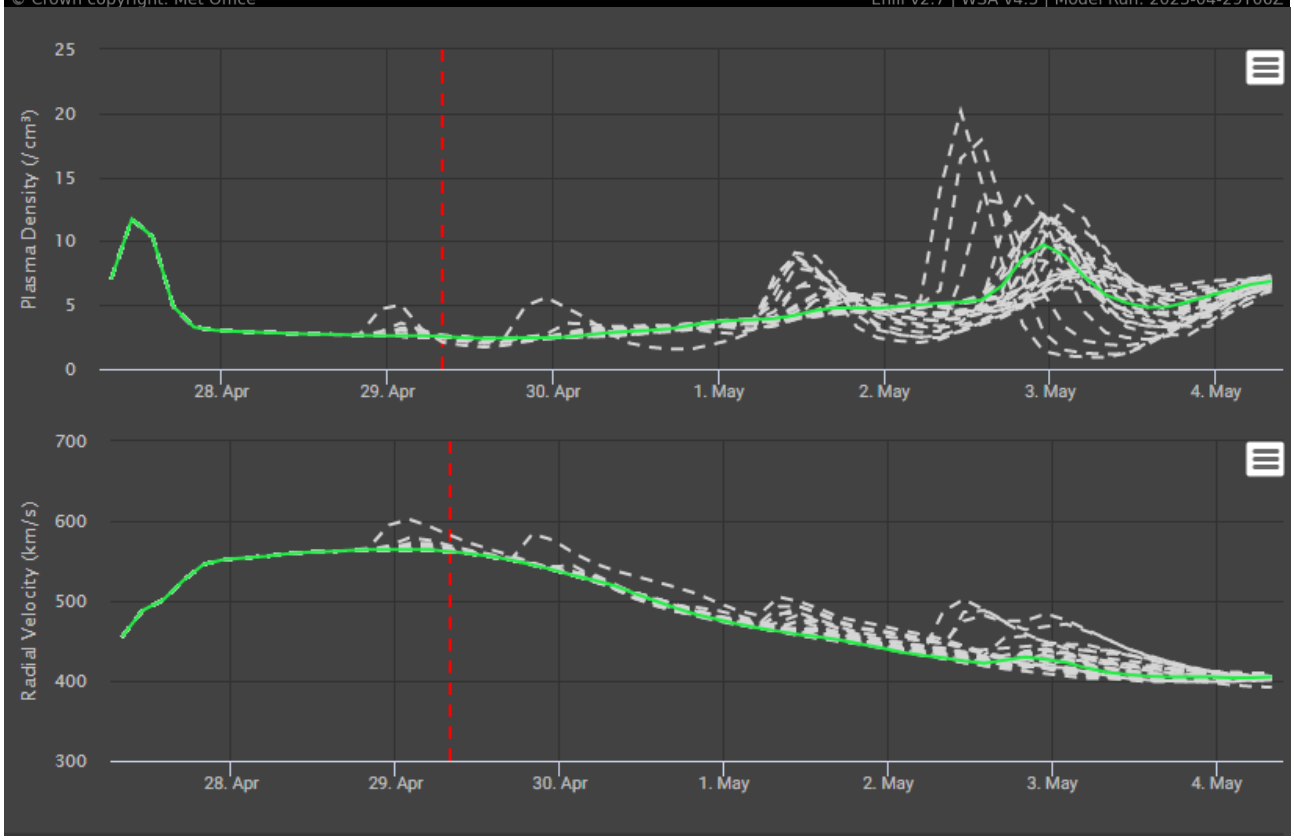
Met Office Space Weather Technical Forecast





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Radio Blackouts - X-Ray Flares:
There are currently five sunspot regions on the visible disc. The largest sunspot group on the disc with the highest flare risk remains AR3288 (Esi/Beta-Gamma-Delta), which has seen growth of the intermediate spots with a clear 'delta spot' in this area. Its proximity to AR3285 (Cso/Beta) may also help to increase magnetic instability. AR3289 (Dsi/Beta) has also seen growth of intermediate spots. This region has a north-south magnetic alignment, which could increase the instability of this group. The other two regions are small and more simple at present.

Currently, there are no significant far-sided regions expected to rotate onto the disc, with none of the near sided regions due to rotate off. As such, flare risk has been kept flat through the four days with a chance of M-flares, mainly from AR3288 but perhaps also from AR3289.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: GOES-16 X-Ray Flares.

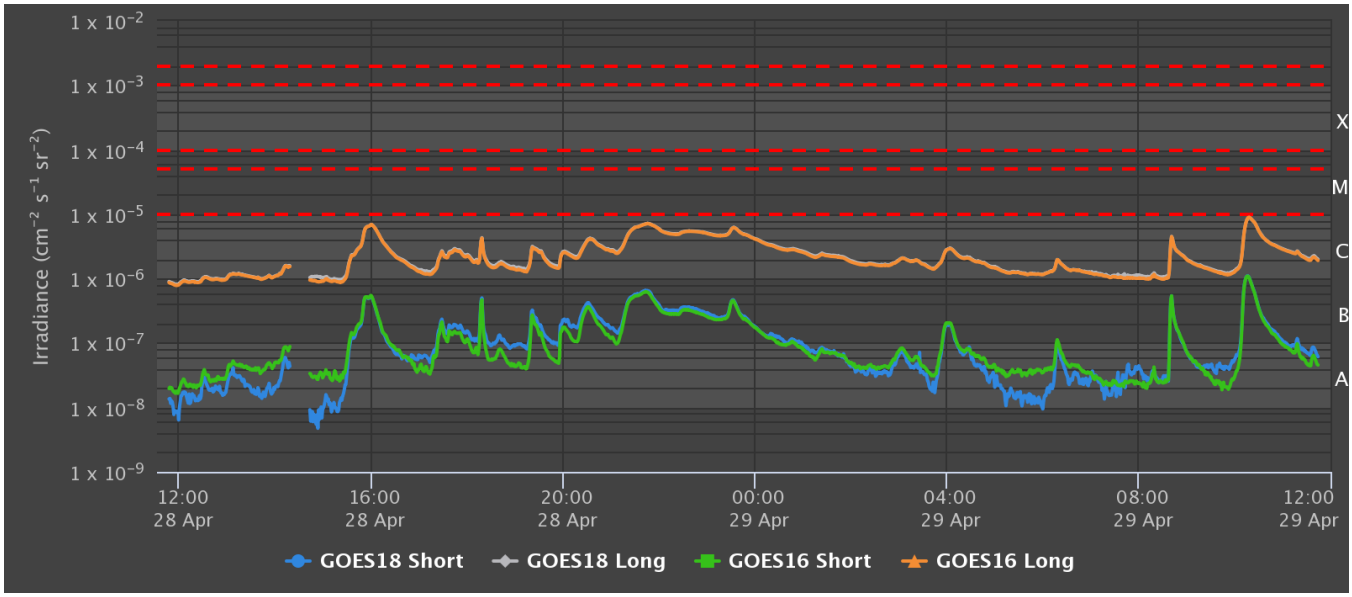

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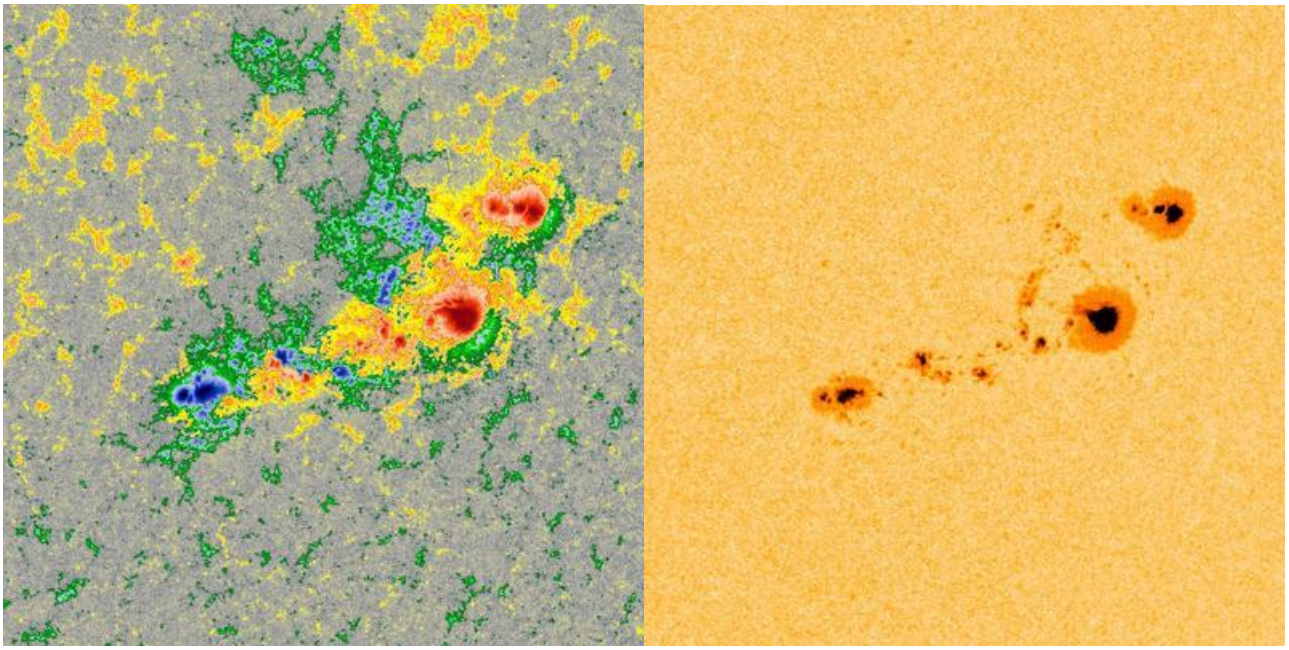
Figure 4: SDO magnetogram and intensitygram of AR3285 (left) and AR3288 (right). AR3288 has a obvious 'delta' region in its intermediate spots.



Solar Radiation Storms - (High Energy Protons):

No solar radiation storms are expected, but there is a slight chance of a storm occurring over the four days due to the westward advance of AR3288.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy (greater than 2MeV) electron flux at GEO is currently at High levels, and is most likely to continue to reach High levels at the diurnal maxima through the coming days. The BAS radiation belt model is suggesting that electron density has significantly increased below GEO, likely due to a combination of recent CME and HSS effects. As the current HSS wanes, it is likely that electron flux will increase further through this period. Although there is a low risk of some glancing CME influence, it is considered most likely that these will miss Earth entirely, allowing the flux to stay at High levels.

Electron fluence is currently above the Active (1e8 integrated pfu) threshold, and is most likely to stay that way through the period, perhaps on a rising trend. MOSWOC REFM is also forecasting an above Active trend, increasing confidence in the forecast. The very slight risk of any CME influence could cause a drop in fluence level, however.

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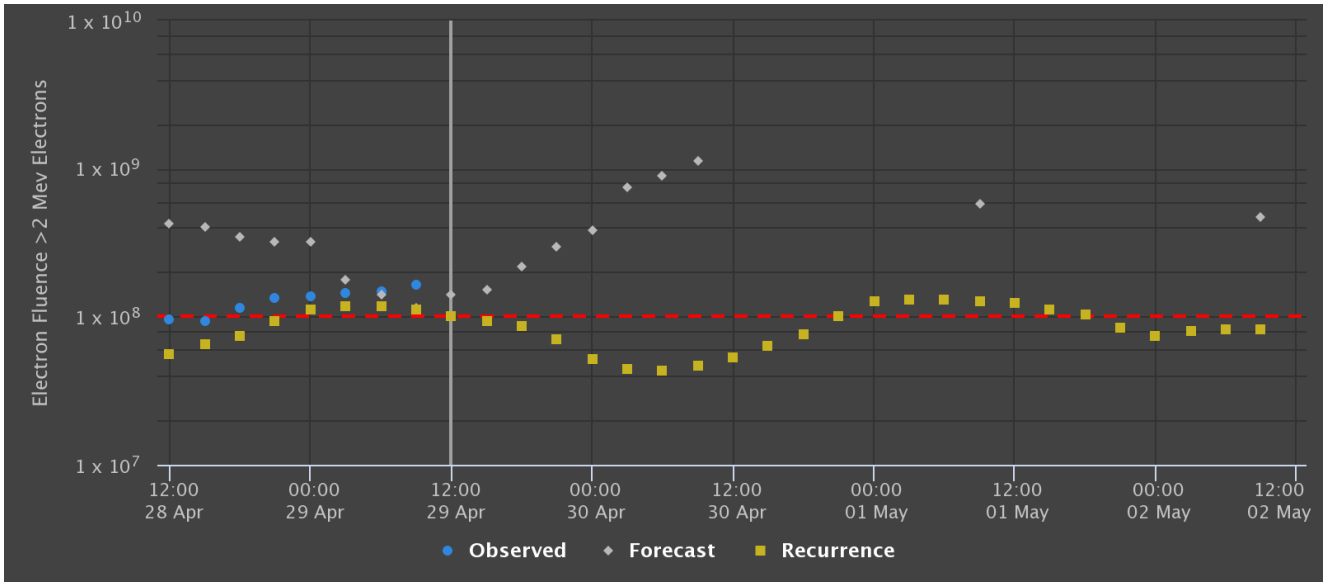
GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	100	90	80	80
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	5	10	10

Figure 5: MOSWOC REFM electron fluence shows above Active forecast for next 3 days.



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